RESEARCH AND DEVELOPMENT

EXTERNAL PROJECTS SECTION

December 1964

I. PROJECTS

1. CV-20 CONVERTER

When the CO/A-8 coder is used with the KE-8 or KE-29 keyers, it is necessary to convert the resulting complementary eight level Baudot information to standard Baudot. The CV-20 converter has been designed for this purpose. The converter is interface between a magnetic tape reproducer and a standard 100 WPM M-28 teleprinter. The signal from the tape reproducer is an interrupted 800 cps to 6 KC tone which is converted to a standard Baudot format capable of neutral current keying a 20 to 60 MA, 120 volt line. Additional characteristics of the CV-20 include a stacked visual display; one CRT provides a frequency display as an aid to tuning the incoming signal to the center of the band pass filter; the second CRT displays where the adjustable sampling point occurs within the bit stream. The CV-20 is powered from a 110/220 VAC, 50/60 cps power source.

The development stage was characterized by the usual minor problems (unwanted noise, excessive hum and distortion of signals), but these problems did not develop into major proportion. Two prototypes were delivered to R&D in November, 1964, for a preliminary evaluation. Initial results indicate that noise-free input signals produced virtually error free copy. However, when noisy signals were used or instantaneous speed variations were evident from the tape reproducer, many errors were produced in the M-28 copy.

To compensate for the effects of poor signal-to-noise ratio and/or speed variations, the bandwidth of the tone filter was increased from 180 cps to 5 KC. Additional tests were performed and significant improvements were evident in the output of the modified unit. Both units (one modified) are presently at the Lab for an A&A, and an error comparison will be made upon completion.

2. CV-19 BAUDOT-TO-MORSE CONVERTER

The CV-19 is a Baudot-to-Morse converter which automatically converts teleprinter tape used with a standard teletype "TD" to a Morse code output suitable for keying a transmitter over a keyline. The Morse code output is variable from 3 to 30 WPM and is capable of neutral current keying a 20 to 60 MA, 120 volt line. Special functions incorporated in the CV-19 are: long number conversion to a cut number system (ECN and ACN) and a reversal mode (Letter). This equipment was developed primarily to replace a variety of machines being employed in base radio stations in the preparation of auto-Morse broadcast tapes, the keying of transmitter in the auto-Morse mode and the conversion of Baudot tape to Morse signals.

A contract was initiated with [redacted] 25X1A5a1 for the design and development of the CV-19 converter in June, 1963. Two prototypes were delivered to the Lab for A&A and were found to be well designed and operationally acceptable. The balance of the production quantity (18 units) was delivered in May, 1964 and the contract was terminated shortly thereafter.

While this development was relatively straightforward, some minor problems have developed in the field with the CV-19's. In at least three separate instances, a number of P.C. boards were found to be warped and extremely difficult to reinsert in their respective connectors. Since only a limited history is available at this time, the extent of this problem is not known. However, the contractor is presently investigating methods of alleviating this condition in the new production run of the CV-19's. It should be mentioned that the CV-19 won fast acceptance in base stations, becoming a work-horse item from the start.

3. CV/A-19 BAUDOT-TO-MORSE CONVERTER

Based on the popularity of the CV-19, an additional quantity was desired. Reflecting several improvements, the second production item is called the CV/A-19. The CV/A-19 is a Baudot-to-Morse converter unit which automatically converts teleprinter tape used with a standard teletype "TD" to a Morse code output suitable for keying a transmitter over a keyline. The primary function of the CV/A-19 is identical to the CV-19; however, certain additional features have been added to the CV-19 to extend its versatility. Two of the major modifications are: (1) provide the capability of operating over a keying range of 3 to 300 WPM Morse code rather than the present 3 to 30 WPM keying rate; (2) provide for local operations through

the mounting of a parallel tape reader unit on the front panel of each new converter. To provide the same local/remote feature to the CV-19's now in service, a separate tape reader assembly is being developed. This reader, called the TR-1, will be packaged for mounting in a standard 19" rack and will be a dual unit consisting of two individual tape readers, each serving its respective CV-19. In addition, an MWO is being written up to provide the higher keying rates in the CV-19's now in the field.

A contract was initiated in November, 1964, for the procurement of twenty CV-19 converters. An amendment to incorporate the above modifications is presently being initiated. Delivery of the CV/A-19 is scheduled for June, 1964.

4. CV-22 MORSE-TO-BAUDOT CONVERTER

The CV-22 is a Morse-to-Baudot converter which translates incoming 300 WPM standard Morse to standard Baudot code. Signal source for the CV-22 is the CV-13 frequency converter whose output is a 10 KC signal. The CV-22 provides a six bit parallel information signal compatible with the input of the DR-4 [redacted] visual message display and teletype readout system. The DR-4 automatically stores the incoming message from the converter on a rotating magnetic drum and displays it on a 17 inch CRT. The drum can also feed a modified M-28 typing reperforator operating at 100 WPM.

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The CV-22 represents the second attempt at providing a code converter for the DR-4. The initial converter, built by [redacted] as part of the DR-4, proved to be unstable and had a poor dynamic range. A second contractor, [redacted] was found to have a proprietary Morse-to-Baudot converter which could be modified to meet our requirements.

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A contract was initiated with [redacted] for the development of the CV-22 in April, 1964. One prototype was delivered to the Lab and mated with the newly refurbished DR-4 [redacted] in November, 1964. A preliminary operating evaluation uncovered a few minor problems with the IDY and EOM signals. Noise resulted in random characters being generated before and after the message. Methods are presently being investigated by [redacted] to eliminate these unwanted characters. A request for A&A has been initiated.

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5. HG-100 HANDCRANK GENERATOR

The RS-100 program has a requirement for a rugged, lightweight, portable, handcranked generator. This generator designated the HG-100 will be capable of supplying 75 watts of average power and 150 watts of peak power at a regulated 12 volts DC. Weight and size reduction is a primary design goal with upper limits of 10 pounds and 230 cubic inches, respectively.

At the time the RS-100 program was initiated, we surveyed industry and military sources to determine their state-of-the-art and progress in the hand generator field, and learned that the military (USAELRDL) was engaged in a thorough study and development of the tactical generator problem which would result in a unit (the G-54) very close to our RS-100 requirement. Whereas the G-54 delivers 50 watts, the HG-100 shall deliver 75 watts from a nearly identical package.

25X1A [redacted] has been under contract for several years developing the G-54. This work has provided an excellent foundation of engineering design which will now permit construction of the HG-100. [redacted] has submitted a proposal for the development and construction of twenty HG-100 service test models. This proposal has been accepted and a contractual agreement with [redacted] is now being negotiated. The first HG-100 is scheduled for delivery in June, 1965. 25X1A5a1 25X1A5a1 25X1A5a1

25X1A5a1 6. RT-66 TRANSMITTER - [redacted]

The contract to develop the RT-66 was initiated on 29 June 1964. The transmitter was delivered on 22 December, three and one-half weeks ahead of schedule. According to the contractor's test data, this transmitter meets all of the specifications, which are essentially the same as for the RT-49 transmitter, the exception being a minimum of 20 watts output over the band and the use of 12 volt DC for all power supply voltages.

The RT-66 project was initiated when we discovered that [redacted] has had considerable experience designing solid-state high power HF transmitters. Most of this experience was accumulated designing such items as the AN/PRC-70 and the PT-5. We discovered these talents when the company bid for the manufacture of the RT-49. They were not low bidder for the RT-49; however, they had so many good ideas that we decided to exploit their capability. 25X1A5a1

[redacted]

By way of comparison, the RT-66 is about 2/3 the size of the RT-49 and, of course, does not require a DC-to-DC converter or special battery pack for its operation. The actual size of the unit is 1 1/2" x 4" x 3 5/8" and the weight is 1.22 pounds. According to the [redacted] test data, this transmitter is also superior to the RT-49 in harmonic suppression and in fundamental feed-through. The efficiency of the transmitter varies from 48% in the worst case up to 58% in the best case. The RT-66 will be sent to the R&D Laboratory for analysis and appraisal and then to OC-OS for operational evaluation. We can see areas where improvements can be made to this transmitter; however, the design is very attractive for an engineering model and it appears that it will be a useful agent device. 25X1A5a1

7. SY-3 VOICE MESSAGE SYNTHESIZER

In June, 1963 a contract was awarded to [redacted] for the manufacture of ten SY-1A voice message synthesizers. These synthesizers were capable of storing eight bands of 100 eight-second messages for transfer to standard 1/4" magnetic tape for broadcast. This production contract was based upon development model of the SY-1A from [redacted]. Though the ten production units were representative of the development model and met all technical specifications, they were complicated to operate and were slow in operation. It was determined that assembly of the final program tape used for broadcast should be as automatic and rapid as possible. Mechanical limitations inherent within the SY-1A precluded modifying it for faster operation, so it was decided to solicit proposals for a new synthesizer to meet the new requirements. This new synthesizer shall be referred to as the SY-3. 25X1A5a1 25X1A5a1

The SY-3 will be a one-way voice message synthesizer designed to prepare a voice message program tape from a master storage medium for broadcast. Information may be selected from the master storage medium by either a keyboard or a Baudot code paper tape reader input. The program tape assembled for broadcast shall have a variable group rate from 5 to 15 word groups per minute. The master voice storage medium shall be easily interchangeable for different areas and/or languages of operation. In addition, information shall be readily recorded and erased from the master storage medium.

Proposals for the development of an engineering model are currently being solicited and qualified contractors. Proposals are due by 19 February 1965 and this contract should be awarded by 1 March 1965.

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9. OS-12 FREQUENCY OSCILLATOR

The OS-12 is a compact, stable variable frequency oscillator for transmitter excitation. It is to have frequency range of 2 - 30 MC, all spurious levels at least -65 db, and an accuracy of ±140 cps at 2 MC to ±1000 cps at 30 MC. The final package is to be 6 to 8 cubic inches. One engineering model is scheduled for delivery 28 May 1965.

The primary advantage of this unit is that it is designed to provide excitation with accuracy comparable to our synthesizers at less cost. It is not termed a synthesizer, as it does not have the accuracy of its reference frequency.

The project was initiated 28 October 1964 and has remained on schedule thus far. The first phase of the program included primarily the design and performance evaluation of circuits deemed to be critical. These critical circuits include two VCO's, the spectrum generator, two mixers, the IF amplifier, and the frequency/phase detector.

All of the above critical circuits have been breadboarded and evaluated as scheduled and are no longer considered critical. These breadboards have now been interconnected in the phase locked loop, which is now pulling and locking in all but 5 KC at each end of the desired 1 MC range. One month is left in the schedule for evaluation of the phase locked loop. A DC amplifier will be built and incorporated to supply the voltage needed to enable the loop to pull and lock throughout the entire 1 MC design range goal.

25X1A5a1 [redacted] will be holding a design review 21 January 1965, at which time all circuits will have been breadboarded. From this point on primary emphasis will be placed on what is practical; viz., cost and size considerations, packaging, and minimizing power consumption.

10. RS-43 MICROWAVE COMMUNICATIONS SYSTEM

In April of this year, [redacted] was authorized to proceed with the fabrication of eight service test model RS-43 sets on the basis of our satisfactory evaluation of the engineering models. The road had been long and filled with disappointments, but there was a good deal of confidence that the engineering models could be easily reproduced (with the necessary minor changes) and the service test models would be delivered in September. Such was not the case; the first two service test models were delivered this month. 25X1A5a1

Construction started to lag in June because of late delivery of many purchase parts, including both components and chassis castings necessary to complete the subassemblies. The mixer-switch-IF subassembly developed two major problems: the diodes would not switch and the 10.7 MC IF frequency was circulating within the subassembly package, causing regeneration and, consequently, loss of receiver sensitivity. The diode manufacturer had discontinued the diode which the switches were designed to use, and the new diode did not operate properly in the circuit designed for the original diodes. This problem was solved by redesigning the biasing networks around the parameters of the available diodes and by measuring and matching the diodes used in each switch. The regeneration was found to be caused by the 10.7 MC IF frequency setting on the switch diodes through their biasing leads and being fed through the switch and mixer to the IF amplifier input. This problem was solved by reworking the switch chassis to allow room for line filters in the switch bias lines.

Major problems were also encountered in the solid-state source. The power required to operate the system was not developed. First, the transistors in the multipliers and the power chain had lower gain than the pilot production models used to build the two engineering models and were not developing enough power to drive the varactor multipliers; and second, the final varactor tripler was not as efficient as those in the engineering models. The driver amplifier was reworked to provide for two transistors in parallel operation, and the varactor multiplier which was driven by the power amplifier was changed from a shunt-type circuit to a series circuit.

As a result of these changes, we received two service test models that are significantly superior to the engineering models. Power output in the transmit mode has been improved from less than 20 milliwatts to more than 40 milliwatts. Local oscillator radiation in the receiver mode has been reduced from more than .4 milliwatts to less than .02 milliwatts. The minimum discernible signal in the receiver has been reduced from 1.2 millivolts to .7 millivolts. The current drain has been reduced by 10%. The operating voltage range has been increased from 13-15 volts to 10-15 volts.

Two RS-43 service test models are presently at the R&D Lab for analysis and appraisal. The remaining six sets will be delivered in January and February.

11. AR-20 AUTOMATIC SCANNING BASE STATION RECEIVER

The AR-20 is an automatic scanning base station receiver for the reception of unscheduled agent transmissions. This receiver is capable of receiving on as many as 2,800 different 10 KC wide channels between 2 and 30 MCS. The receiver is programmed to sweep only selected channels and a maximum of 7 MCS bandwidth can be assigned for observation at any one time. Sweep time is a direct function of the number of channels programmed requiring five seconds for the maximum of 7 MCS.

25X1A5a1 In June of 1964 [redacted] contracted to construct the AR-20 at a cost of $196,183. The program will result in the delivery of one prototype receiver in March, 1965. Approximately 80% of the system has been fabricated and of this amount about 50% has completed testing and is ready for installation into the equipment drawers. When complete, the station will occupy two standard equipment racks.

Recent discussions with [redacted] have indicated that a number of modifications can be made to the AR-20 which would increase the receiver's flexibility, thereby adding to its usefulness in an operational environment. At our request, [redacted] submitted proposals for making seven modifications to the AR-20 equipment. Two of these changes, the multiple band recording and the multiple antenna switching, are unnecessary at this stage of development and are not being requested. The remaining five modifications are critical to the subsequent operation of this prototype and shall be incorporated into the equipment. 25X1A5a1 25X1A5a1

These changes are as follows:

a. Frequency Display - This unit is needed to indicate the exact 5 KC subchannel from which information is being recorded. With this readout an operator can directly determine the activated subchannels.

b. 5 KC Channel Selection - The selectivity of the present design is 10 KC. Reliable reception of agent broadcasts is significantly improved if the selectivity is narrowed to 5 KC.

c. Adjustable IDY - Recognition depends upon there being a short interruption in the IDY signal. The exact position and duration of this interruption is difficult to assign until field-tested. An adjustable IDY in the AR-20 would allow the recognition circuit to be easily adjusted to the optimum sequence.

d. Subchannel Block Out - When portions of the HF spectrum being scanned exhibit signal patterns which are either particularly troublesome or allocated to other services, then it is desirable to have a means whereby discrete subchannels can be bypassed without eliminating adjacent pertinent subchannels. The subchannel block out unit would allow this mode of operation.

e. Removable Program Board - The AR-20 has a program board that tells the receiver which subchannels to scan. Removable boards would allow the operator to set up several scanning programs in advance. At any desired time the boards could be quickly interchanged thus allowing a minimum of off-the-air time.

These channels will cost $53,430 and require approximately thirty additional days for completion.

12. HG-49 MINIATURE HANDCRANK GENERATOR

The HG-49 is a miniature handcranked generator for charging batteries associated with the RS-49 equipment. The complete generator measures 2 1/4" x 3 3/4" x 5 1/2", enclosing a 10-watt alternator driven by conventional spur gears. The 1000 cps output is current regulated to 90 MA for charging the BS-49 battery supply. The battery pack contains a diode bridge for rectification of the A.C. from the HG-49. Other charging rates are possible by exchanging regulator circuits, thereby allowing the generator to charge other batteries.

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has an extensive background in the handcranked generator field and is submitting a proposal to develop the HG-49.

25X1A5a1 [redacted] is basing their design on a feasibility model they have constructed and demonstrated to be potentially capable of meeting our requirements. Delivery of the first prototype HG-49 is expected within ninety days of contract initiation.

II. ADMINISTRATIVE

TDY

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16 December
16-17 December
18 December
18 December
2 December
15-16 December
15 December
17 December
14 December
27-28 December
16 December
16-17 December
18 December
18 December
15-16 December

TRANSFERS

N. A.

PCS

N. A.

EOD

N. A.

RESIGNATIONS

N. A.

EFFECTIVE PROMOTIONS

N. A.

TRAINING

N. A.

OTHER

N. A.